Gartner Research

Top Strategic Technology Trends in Asset-Intensive Manufacturing for 2023

Alexander Hoeppe, Jonathan Davenport, Sudip Pattanayak, Simon Jacobson, Marc Halpern, Arjun Boparai, Christian Hestermann

31 March 2023

Gartner®

Top Strategic Technology Trends in Asset-Intensive Manufacturing for 2023

Published 31 March 2023 - ID G00784842 - 29 min read

By Analyst(s): Alexander Hoeppe, Jonathan Davenport, Sudip Pattanayak, Simon Jacobson, Marc Halpern, Arjun Boparai, Christian Hestermann

This research examines top strategic technology trends in asset-intensive manufacturing for 2023, focusing on product complexity management, data monetization, frontline worker engagement and automation. CIOs should inform the leadership team of these opportunities while defining digital ambition.

Additional Perspectives

- Summary Translation: Top Strategic Technology Trends in Asset-Intensive Manufacturing for 2023
(13 June 2023)

Overview

Opportunities

- While automation in manufacturing is a must, human augmentation is a necessary step toward eliminating the manual and involving humans in their work, elevating existing jobs and creating entirely new roles and specializations.
- Cheaper data collection using sensors removes the barrier to equip almost all industrial products with edge devices while advancements in AI opens new opportunities to mine the right information and intelligence.
- Industrial cloud platforms and maturing connectivity standards facilitate deployment and scalability of proofs of concepts (POCs) into typically complex industrial manufacturing organizations.
- Optimizing products based not only on functional criteria, but also on manufacturability, serviceability and even sustainability criteria, and making the configurable across all these domains enables manufacturers to reduce life cycle costs while improving the customer experience.

Recommendations

Asset-intensive manufacturing CIOs driving digital transformation and innovation should:

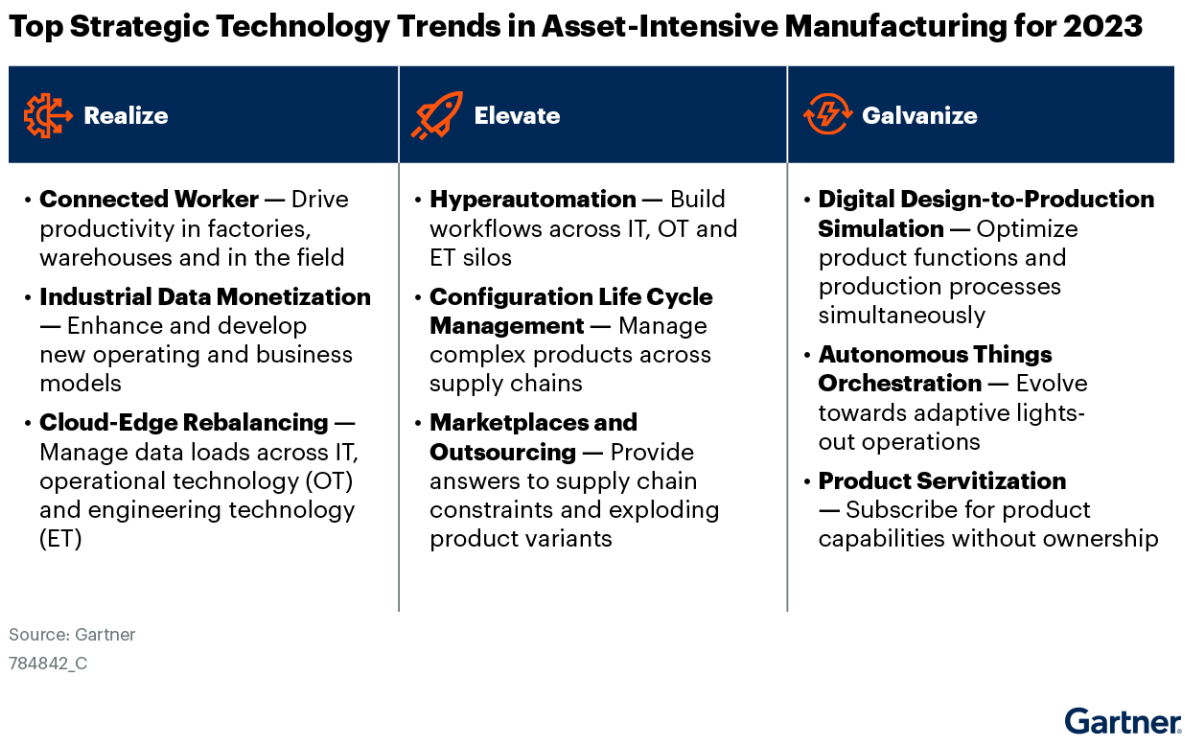
- Identify what digital experiences will improve workers' lives by simplifying their interactions and ability to execute methods and procedures tied to their role(s). Over time, prepare to partner with manufacturing leadership and HR and finance to upgrade job families and role profiles — including creating completely new roles and specializations.
- Build data structures for monetization that are simple, easily analyzed and abstracted from complex engineering information by incorporation of data and analytics (D&A) rules that are able to map and provide insights with a quick turnaround.
- Develop and deploy applications that enable collaboration beyond your organization's boundaries (i.e., engineering collaboration, tracking of inventory, demand tracking or customer service) by utilizing industrial cloud for joint development of industry solutions with your ecosystem partners.
- Optimize products based not only on form-fit-function criteria, but also on factory layouts and field operating conditions by integrating engineering systems with supply chain systems, extending simulation functionality to more complex data models using MBSE and introducing simulation governance.

What You Need to Know

The trends affecting asset-intensive manufacturing are strongly related to optimizing processes, digitalizing the product and making the best of limited resources. Asset-intensive manufacturers face increasing pressure from managing life cycle costs, availability of raw materials and components, changes in supply and demand, and producibility or sustainability characteristics.

Figure 1 shows top asset-intensive manufacturing trends. Cross-manufacturing and transportation trends such as supply chain resilience or sustainable enterprise are included, but they also apply for asset-intensive and often energy-intensive manufacturing industries that produce complex products (see Top Strategic Technology Trends in Manufacturing and Transportation for 2023).

Figure 1: 2023 Asset-Intensive Manufacturing Trends



The top strategic technology trends in asset-intensive manufacturing for 2023 are presented in Table 1.

Table 1: Trend Profiles: Click links to jump to profiles

Realize	Elevate	Galvanize
Connected Factory Worker	Hyperautomation	Digital Design-to-Production Simulation
Industrial Data Monetization	Configuration Life Cycle Management	Automated Things Orchestration
Cloud-Edge Rebalancing	Marketplaces and Outsourced Manufacturing	Product Servitization

Source: Gartner (March 2023)

Realize

Connected Factory Worker

Analysis by Simon Jacobson and Scot Kim

SPA: By 2026, 50% of factory work will be done remotely, impacting job families and shift schedules.

Description:

Connected factory workers leverage various digital tools and data management techniques to improve and integrate their interactions with both physical and virtual surroundings while improving decision accuracy, proliferating knowledge and lessening variability.

Why Trending:

- Automation is a necessity in manufacturing and there are ample opportunities. However, labor constraints and process trade-offs place completely lights-out production farther out on the horizon.
- Human augmentation is a necessary step on that journey to eliminate the manual and integrate people with their work. It also supports upgrading existing jobs and creating completely new roles and specializations.
- Digital dexterity and increased data literacy are nascent with factory workers, creating urgency to reinvest in learning and development.
- Pioneering organizations are offering a new “human deal” to frontline workers by defying convention to build a better experience for production and distribution center employees.
- Core operational excellence and performance baselining in factories require human inputs.

Implications:

Labor constraints, flexibility imperatives and a lack of digitization outside of core processes in factories create a significant challenge with maximizing the current workforce. This creates challenges for factory workers to embed new technologies into their daily work, impacting their daily experience and output, and creates challenges for manufacturers, as people are critical to overall digital transformation in manufacturing operations. Artificial intelligence (AI) plays a significant role, but recommendation engines and bot-based architectures will rely on scale and knowledge curation over time. Instead, look for the tried and proven AI use cases such as natural language processing (NLP), conditional logic for forms and checklists, and robotic process automation (RPA) in the early on/initial deployments (for other technologies, see Hype Cycle for Frontline Worker Technologies, 2022).

Manufacturing CIOs must understand that the connected factory worker is a strategy. No single technology is the solution. Multiple technologies traversing IT and operational technology (OT) are required as connected worker initiatives are usually part of broader smart factory initiatives. The Connected worker strategy needs to be integrated with the overall manufacturing workforce strategy, which is anchored by three components: knowledge curation, talent management and organization design.

Actions:

- Start with the worker. Identify which digital experiences will improve a day in their lives by simplifying their interactions and ability to execute methods and procedures tied to their role(s). Over time, prepare to partner with manufacturing leadership, HR and finance to upgrade job families and role profiles — including creating completely new roles and specializations.
- Focus on core operational excellence as a low-risk/high-reward way to prove the value of providing factory workers new digital experiences by efficient usage of technology to facilitate interoperability between people and machines. Eliminating human error provides returns and will reveal improvement opportunities.
- Reinvest in learning and development by focusing on self-paced learning. Therefore, make training more interactive by deemphasizing formal classroom-based learning in favor of experiential and relationship-based learning that happens in the flow of work.

Further Reading:

How to Take a Life Cycle Approach to Developing the Connected Factory Worker

Quick Answer: How Can I Develop New Factory Workers as the Digital Operating Environment Emerges?

Industry Insights: Hyperautomation in Manufacturing Will Transform Human Intervention

Industrial Data Monetization

Analysis by Sudip Pattanayak

Description:

Industrial data monetization refers to the process of using data to obtain quantifiable economic benefit. For example, an industrial battery manufacturer will collect and monitor its performance data. Internal or indirect methods include using data to make measurable business performance improvements and inform decisions (see Quick Answer: How Do I Get Started With Data Monetization?). Manufacturing companies have been building D&A capabilities across the value chains, but struggle to transform that data into financial benefit. Data-collection capabilities have increased substantially in the past few years. This is due to the Internet of Things (IoT) and cloud-enabled technologies, but the increasing mindset of data ownership and protection in combination with complex regulations prohibits using data for economic benefits with ease.

Why Trending:

The pandemic has accelerated changes to the manufacturing workplace and workforce, including shifts in customer demands and supply chain constraints. Unless the data analytics are predictive and prescriptive — enriching customer experience in the end-to-end process delivering the highest product quality in a shorter turnaround time — data-driven intelligence will be limited to business operations without adding commercial advantage.

Also, the chances of monetizing data are higher from a new product. The new product's architecture will be modern, with built-in data collection, edge computing and connectivity to cloud and D&A platform features. Adding the same capabilities in legacy products by retrofitting is much more challenging, but is becoming critical as well due to pressure margins, productivity upscale goals and cost reduction targets.

CEOs desire their organizations to become a data-driven technology company and maximize product servitization models. They expect CIOs to develop IT infrastructure that can identify reliable data sources and scale the D&A practice by working closely with innovation and product development teams. Building optimal data infrastructure could be an obvious path, but that may take years to realize. Therefore, data already in hand could be a good starting point to launch a proof of concept (POC).

Implications:

- **Data structures need effort for external usage:** Most data structures are built for internal use. The attributes can benefit the needs of internal business processes, but not of the customers. Financial returns can be significant by monetizing external data and requires more effort.
- **Diligently prepare the data:** Proliferation of data is another concern. Sensors have made data collection cheaper/easier, thereby increasing the use of both data sensors and edge devices for industrial products. However, mining the right information and intelligence is overwhelming the benefit of data.
- **Interconnected products offer higher benefits:** Products are interconnected, or utilized in the context of their relationship to other products, they are “smarter” and can better gather data in shared spaces and ecosystems

Actions:

- Identify industrial data monetization use cases — both internal and customer-facing — with associated KPIs by applying Gartner’s framework for data monetization (see Quick Answer: How Do I Get Started With Data Monetization?).
- Build data structures for monetization that are simple, easily analyzed and abstracted from complex engineering information. The D&A rules must be able to map and provide insights with a quick turnaround.
- Include data collection modules, smarter at the source of data origin, eliminating and isolating meaningful data from the noise. Add modern edge data-collection devices that control the data collection and aggregation flow from the products to the cloud and enable digital customer services seamlessly.
- Develop comprehensive data taxonomy models that enable layered data-access control rules and protect data-sharing policies in shared product ecosystems.

Further Reading:

Quick Answer: How Do I Get Started With Data Monetization?

Case Study: Data Product Development to Prioritize Data Monetization (ZF Group)

3 Successful Best Practices in Servitizing Products for Manufacturers

Cloud-Edge Rebalancing

Analysis by Alexander Hoeppe, Christian Hestermann

SPA: By 2027, 65% of application workloads will be optimal for cloud delivery, up from 45% in 2022.

Description:

Increasing amounts of data are processed directly at the point of origin, "at the edge." The number of data endpoints continues to increase and even extends beyond company boundaries (see Forecast: Internet of Things, Endpoints and Communications, Worldwide, 2021-2031, 4Q22 Update). Edge devices are becoming more intelligent at the same time, which requires precise screening of environmental parameters, and thus, leads to more real-time data that has to be processed.

Central rules and algorithms are required that ensure secure and efficient interoperability between systems and assets using advanced analytics and AI/machine learning (ML). As a result, manufacturers are investing in cloud solutions or cloud-based IoT platforms.

Finding the right balance between edge and cloud workloads will ensure the appropriate mix of local processing power versus central control.

Why Trending:

Gartner sees continued growth in all three segments: cloud adoption, AI spend and an increase in the number of connected data endpoints (see 2023 CIO and Technology Executive Agenda: An Asset-Intensive Manufacturing Perspective). We also see multiple data aggregation tiers, each of them requiring their individual process rules and data views:

- **Edge:** An example of this would be a machine operator or maintenance worker in a factory (OT) or a design engineer optimizing product designs in a computer-aided engineering (CAE) system (engineering technology [ET]).
- **Platform:** An example of this would be a factory manager monitoring and supervising overall equipment effectiveness (OEE), health or availability in a smart factory control tower.
- **Enterprise:** An example of this would be a COO or CSCO allocating resources across multiple connected factories or supervising collaboration with suppliers, customers and partners in a supply chain command center.

These tiers span across IT, OT and ET and require the right mix of integrated hybrid cloud and on-premises deployments. Data and process governance is a prerequisite to run both business processes and the underlying IT/OT/ET infrastructure as efficiently as possible.

Implications:

A variety of challenges are associated with cloud-edge rebalancing, but there are also opportunities to optimize internal processes and external collaboration.

Challenges:

- **Multitudes of standards and connectivity protocols:** This can include outdated software and hardware and protocols.
- **Lack of Integrated technology and process and methodology skills:** Central administration in cloud-based work environments requires broad, integrated process and industry knowledge of methodologies and standards.
- **Complex vendor ecosystem:** Comprehensive cloud platforms are offered by enablers who sell to a wide variety of industries and, in turn, use partners with special industry know-how to develop edge applications that represent specific use cases.
- **Evolutionary process:** Business software for manufacturing is moving toward the cloud at different paces, while OT hardware and software are being modernized in incremental steps. The ideal balance between cloud and edge must be continuously optimized depending on the expansion stage.

Opportunities:

- **Load balancing optimization:** This can be accomplished by the distribution of data processing capacity due to increasing edge AI applications while minimizing the data traffic over the network.
- **Improved data protection and IT, OT and IoT security:** This includes physically separate storage and multilevel protection of critical and sensitive data in different processing layers.
- **Total experience:** End users need individual views on data from many different endpoints to make better business decisions. Public cloud deployments allow for selective data sharing and contextualized collaboration with suppliers, customers and partners in uniform and standardized frontends.

Actions:

- Introduce "data and process governance" to identify what capabilities need to be implemented at the edge versus cloud versus combinations by utilizing Gartner's IoT reference model (see Create an Optimal IoT Architecture Using 5 Common Design Patterns).
- Follow a composable business-outcome-driven implementation approach by using a stepwise enhancement of the IT/OT/ET infrastructure with additional business capabilities being deployed.
- Build an ecosystem of vendors to design, build and continuously improve your IT/OT/ET infrastructure by selecting partners that combine three skill sets: industry and process, technology and architecture, and change management.

Further Reading:

2023 Planning Guide for Cloud, Data Center and Edge Infrastructure

What Manufacturing CIOs Must Know About Industry Cloud Platform Adoption

Top Strategic Technology Trends for 2023: Industry Cloud Platforms

Elevate

Hyperautomation

Analysis by Scot Kim

SPA:

By 2025, hyperautomation technologies will increase manufacturing jobs that require digital dexterity and data literacy to 65%, up from 13% today.

Description:

Hyperautomation is a range and combination of advanced technologies that can facilitate or automate tasks that originally required some form of human interaction, judgment or action when it comes to manufacturing operations. The term “tasks” refers to not only tasks and activities in the execution, working or operational environment, but also in thinking, discovering, analyzing and decision making.

Why Trending:

Over the next five years, manufacturing processes and activities are expected to shift increasingly toward hyperautomation to fulfill smart factory initiatives such as autonomous production scheduling and end-to-end order processing (see Win More Business in Manufacturing With Composable Hyperautomation Capabilities). As factories are en route to modernizing their production processes, technologies and culture, hyperautomation is at the forefront of every manufacturing CIO’s strategic goals.

Implications:

Manufacturing is at the precipice of disruption due to internal and external factors (e.g., supply chain shortages, labor constraints, increased demand on products and customer customization requirements). Manufacturing CIOs have the responsibility to elevate manufacturing and warehouse operations to not only meet, but to exceed the demands of the customer. If hyperautomation is not a part of the CIO’s overall transformation strategy, then the overall ability to achieve higher manufacturing maturity will be compromised (see Roadmap to Assess and Advance IT Maturity in Manufacturing).

Actions:

- Ensure that constraints will not happen within the value chain of manufacturing by integrating production and logistics functions together through IoT technologies.

- Establish a digital fusion team that consists of IT, OT and ET and lines of business. Start with a few simple key processes and technologies (see Survey Analysis: IT/OT Alignment and Integration).
- Conduct design thinking workshops to introduce and engage employees with the concept of working with robotics, AI and hyperautomation technologies. Showcase examples and work with technology partners to create an immersive learning and sharing experience.
- Develop and then exploit hyperautomation competency by creating a hyperautomation center of excellence that covers the entire life cycle from exploration to governance and control.

Further Reading:

Win More Business in Manufacturing With Composable Hyperautomation Capabilities

Hyper-Automation Is Changing Factory Workers' Jobs, and IT Will Help With the Transition

Roadmap to Assess and Advance IT Maturity in Manufacturing

Configuration Life Cycle Management

Analysis by Marc Halpern, Sudip Pattanayak, Alexander Hoeppe

SPA: By 2026, configuration life cycle management will transform 40% of manufacturers, reducing the amount of customer-specific engineering required to deliver products.

Description:

Configuration life cycle management comprises system-of-systems configuration that employs system engineering techniques to define and execute configurations of products, manufacturing processes and sales and service options in connected and orchestrated ways. It comprises an integrated product architecture with centralized and integrated rule engines enabling configuration of technical, feasible product variants and saleable/serviceable variants, and simulations of production scheduling to predict the time to customers.

Why Trending:

Manufacturers are striving to maximize market coverage and customer engagement with products that take optimal advantage of the R&D investments they make. The potential of system-of-systems configuration varies by manufacturing market segment due to different customer needs and how each segment designs, manufactures and services its products. It is most relevant to asset-intensive manufacturers in engineer-to-order businesses selling customized machinery.

Implications:

Customers in different markets want a common category of product, but they want different features. This approach satisfies that preference by making complex configure-to-order (CTO) and engineer-to-order (ETO) business more scalable and enhancing reusability of R&D investments. It enhances R&D leverage through reusability because it accelerates standardization of product modules and manufacturing processes, supply chain processes (logistics), and service operations, making them more scalable and efficient. These benefits align with the manufacturing trend toward composability and mass customization.

This approach to managing the life cycles of product configurations also enhances customer loyalty given the efficient customization of products and services. Since such modularized product architecture based on system engineering reduces or eliminates ETO needs, this configured product approach reduces time to delivery for individual customers for products and services.

Actions:

- Apply model-based system engineering (MBSE) approaches to defining product configurations.
- Invest in requirements management software and configuration management software to define a limited set of modules that can be efficiently assembled into a broad variety of products that serve various needs of different customers.
- Collect the range of customer's product requirements from different target markets and organize them into a unified structure. This action produces modular product architecture which makes fulfilling customer demand faster and cheaper than designing individual products for different customers in different markets. Prioritize the ability to connect enabling applications by implementing standardized APIs and centralized product platforms.

- Partner with internal and external stakeholders including internal sales, marketing, and manufacturing roles, suppliers and customers to build the system architecture of product platforms and to define the processes of working with those platforms.
- Create fusion teams consisting of stakeholders from IT and involved business functions to improve coordination of design, sourcing, manufacturing, and sales activities needed to design and deliver configured modular products. .
- Cultivate composable thinking through (1) education focused on composability concepts, (2) modified key performance indicators (KPIs) for the business and (3) modified job performance metrics that align to composability concepts. .

Further Reading:

Hype Cycle for Manufacturing Digital Transformation and Innovation, 2022

Marketplaces and Outsourced Manufacturing

Analysis by Arjun Boparai

SPA: By 2025, more than 80% of manufacturers will have outsourced parts or all production processes to external manufacturers, compared with 46% in 2022.

Description:

Manufacturing marketplaces provide an on-demand manufacturing platform by creating a robust ecosystem among local contract manufacturers that helps manufacturing companies to increase efficiency and flexibility, reduce costs and optimize capacity utilization. The manufacturing marketplaces are a relatively newer type of service provider. This type has grown through the adoption of technologies such as configure, price and quote (CPQ) tools, 3D modeling, 3D printing (3DP), online data exchange and design validation platforms, and other digitization techniques that are enabled by workflow systems.

Why Trending:

According to the 2021 Gartner Logistics and Contract Manufacturing Outsourcing Survey, more than two-thirds of respondents report that external manufacturer relationships have had a highly positive impact on their enterprise. Traditionally, external manufacturers were considered third-party service providers. However, with increased collaboration with external manufacturers, they are now becoming strategic long-term partners. While cost has always been a key parameter governing the dependence of organizations on external manufacturers, Gartner research shows that a wide array of strategic objectives has become equally important for organizations (see Create Joint Value by Optimizing External Manufacturing Strategies).

As manufacturers attempt to optimize their outsourced manufacturing and supply chain strategies, they have started to engage with contract manufacturers and online manufacturing marketplaces. This is done to increase the focus on decreasing time to market, expanding product offerings or technical and operational skills, and increasing flexibility and agility to overcome the macroeconomic challenges and uncertainties. Additionally, astute organizations increasingly look to third-party manufacturers as supply chain solutions providers, rather than as traditional contract manufacturers. Service providers continue to build portfolios of adjacent, value-added services. These include design and engineering, end-to-end supply chain management capabilities and risk-management tools, both to meet the needs of demanding customers and to supplement razor-thin margins on traditional electronic manufacturing services including printed circuit board assembly (EMS/PCBA) activities.

Implications:

In the wake of external challenges such as global disruptions and market volatility stemming from geopolitical issues, health crises and climate change, manufacturers are facing disruption of their manufacturing operations and supply chain. This involves volatility in resource prices and unpredictable disruption of the supply chain, including labor and skills shortages. Considering this aspect of market movements, contract manufacturers or external manufacturers and marketplaces can help manufacturing organizations in optimizing costs and operational efficiency, increasing agility and flexibility, and reducing time to market. However, manufacturers need to be cognizant of exposure to risks of intellectual property (IP) protection, fluctuating quality levels, inefficient vendor management and governance.

Actions:

- Develop and manage long-term partnerships with external manufacturers by initially using external manufacturers for production capabilities and value-added services such as design and engineering, end-to-end supply chain management capabilities and risk management tools.
- Develop a roadmap to enable priority identification of noncritical production and service-related tasks and increase value by focusing internal resources on sources of competitive advantage. Create steps for success by identifying foundational elements of strategic partnerships, evolving business requirements and participating in long-term joint value creation.
- Create a strategic outsourcing approach, supported by a template to be leveraged in different cases, which focuses on value creation beyond cost by utilizing robust financial analysis to determine the total cost of ownership (TCO). Consider important qualitative factors such as agility, flexibility, end-to-end supply chain capabilities, business continuity management approach and risk management.

Further Reading:

Predicts 2023: The “Triple Squeeze” Will Require Manufacturing CIOs to Gain Visibility by 2026

Market Trend: Emergence of Design and Manufacturing Marketplaces

Create Joint Value by Optimizing External Manufacturing Strategies

Galvanize

Digital Design-to-Production Simulation

Analysis by Marc Halpern, Sudip Pattanayak

SPA: By 2025, spending on design-to-production simulation technologies will increase 30% from 2022.

Description:

Digital design-to-production simulation technologies and practices refer to using software applications that provide the ability to predict product performance and the performance of manufacturing operations for quality, cost and sustainability. This simulation happens before manufacturers commit investments into products, factories, factory equipment, automation, procurement and delegating responsibilities to factory workers. This technology may be used to enhance digital twins.

In discrete manufacturing industries, design simulation tools span mechanical design, electrical and electronics design, software logic and integrated systems design to predict product performance. In the process manufacturing industries, software applications span chemical reactions, mixing processes for fluids and powders, thermodynamics, fluid flows, and integrated system design to validate formulations for function and cost.

Manufacturing simulation refers to software and practices that predict the performance of manufacturing operations and automation. The simulations can include machining operations, assembly processes, automation, human-machine interactions, ergonomics for factory workers in workcells, material flows across the factory and through supply chains, predictions of energy consumption, and sustainability measures.

Why Trending:

Product design simulation eliminates iterations of physical prototype testing that can be enormously expensive. For example, a vehicle crash test can cost hundreds of thousands of U.S. dollars to build, configure, validate, and execute the test, and analyze the results. A simulation costs substantially less to build the model, run the simulation and analyze the results. In the aerospace industry, running prototype tests is cost- and time-prohibitive compared to simulation. Simulation technologies are expanding to all manufacturing industries. The plummeting cost of computing, advances in simulation capabilities and the rapidly expanding accessibility of compute power, most recently to the cloud, makes the case for product design simulation increasingly compelling.

Manufacturing simulation also has a long history, with its roots in computer numerical control (CNC) of machining operations. Machinists automatically generate machine operation code with 3D models, debug the code and port the code to different machines, dramatically increasing a machinist’s productivity. Users create predictive virtual models of machines, processes and humans with today’s computing power and 3D modeling.

Implications:

- **Confidence in product function:** Product simulation increases the confidence that products will function as intended when produced. During the course of design, the technologies also identify trade-offs of alternative design decisions, increasing the knowledge base upon which future design decisions will be made.
- **Supply chain integration:** Manufacturing simulation allows manufacturing engineers and plant managers to assess and improve plant layouts, human activities, material flows, machining/assembly operations, and other automation and supply chain logistics more efficiently before committing to large capital outlays for the physical infrastructure.
- **Data processing capabilities:** These technologies and practices increase the need for high-performance computing and advances in data management as the number of models and the size of models and simulations have expanded rapidly.
- **Need for simulation governance:** Since the business value of the simulations depends on the quality and relevance of the simulation results, a concept called simulation governance is evolving to manage and monitor simulation practices.

Actions:

- Identify opportunities where design-to-production simulation adds value to assess the level of the needed IT investment.
- Make investments in simulation education for product and manufacturing engineers so use of simulation technologies is optimized.
- Adopt simulation pilots on a limited scope and scale simulation use as confidence and successes increase.
- Invest in the needed compute capability either on-premises or cloud-native based on the calculated size of the models, expected complexity of the simulations, and estimated number of simulations conducted annually.
- Support a simulation governance plan to increase the quality and value of simulation activities. Simulation governance refers to a process and discipline to verify that simulation models meet business objectives and simulation results can be validated. [1]

Further Reading:

Hype Cycle for Manufacturing Digital Optimization and Modernization, 2022

Hype Cycle for Manufacturing Digital Transformation and Innovation, 2022

Automated Things Orchestration

Analysis by Jonathan Davenport

SPA: By 2025, manufacturers that utilize an automated things orchestration platform will reduce software integration costs associated with onboarding a new autonomous thing supplier by 80%.

Description:

Automated things orchestration platforms act as an intelligent middleware that integrates and orchestrates work between various business applications, heterogenous fleets of operational robots and other automated agents like doors or elevators. These solutions orchestrate and assign work, and monitor and coordinate the activities of diverse fleets of robots.

Why Trending:

As the sophistication of autonomous things matures, manufacturers are increasing both the breadth of use cases and number of units being deployed. Most autonomous things come with a fleet management software package, but these are not interoperable with each other or building systems. Even for a single material handling use case, there are different devices specifically designed to handle totes, which are different from those required to handle pallets at floor level, and different again from autonomous forklifts and tow tractors. Autonomous things must also integrate with lifts, fire alarms and other building systems, increasing the complexity of deployment.

The breadth of autonomous solutions being deployed causes two issues for manufacturers:

- The high integration costs for enterprise software can make small-scale deployments prohibitively expensive.

- To track specific aspects of fleet management — such as remote diagnostic of issues or pulling specific analytics and reporting data — devices have to be managed across a number of different platforms.

Implications:

Manufacturers that want to adopt autonomous technology to address staff shortages and improve efficiency and effectiveness of operations are faced with huge integration cost challenges. These high enterprise IT system integration costs are further challenged since no one autonomous things provider can deliver hardware to address all use cases. The fact that integrations need to be repeated only magnifies the cost challenge. Utilizing an automated things orchestration platform middleware allows a single integration to different types of robots to be connected, cutting down on complex software integration work and enables optimization applications to be deployed. Platform providers include SVT Robotics' SOFTBOT Platform, Amazon Web Services (AWS) IoT RoboRunner, NVIDIA cuOpt or Open Robotics Middleware Framework (Open-RMF).

Actions:

- Improve the scalability of autonomous things deployments by investing in an automated things orchestration platform that addresses expensive IT core system integration costs that have previously inhibited adoption of new device suppliers.
- Enable more efficient transportation of materials through the manufacturing plant by supporting cross-device communication that allows information such as congestion or blocked aisles to be used to deliver dynamic routing and rerouting.
- Select the most appropriate vehicle to perform a given task by categorizing all autonomous things according to their capabilities (such as load capability or lift height), with all autonomous things forming a pool of resources that can be harnessed.

Further Reading:

Autonomous Things Deployment: 5 Best-Practice Stages That Require Manufacturing CIO Leadership

Emerging Tech Impact Radar: Smart Robots and Drones

To Gain Customers, Product Managers of Autonomous Things Must Simplify Integration

Product Servitization

Analysis by Scot Kim

SPA: By 2026, 58% of manufacturers will generate an additional $25 million in digital revenue by servitizing their products.

Description:

Product servitization is manufacturers' evolution of their product offerings from a product-oriented, sell-and-service model to a service-centric, continuous revenue operational model through IoT-enabled solutions.

Why Trending:

Manufacturing enterprises are under constant pressure to squeeze more profits from their production of goods. According to the 2022 Line of Business Buyer Behavior Survey, manufacturers say that "increasing margin" is their top business priority. With the advent of the IoT, advanced analytics and service models, manufacturing enterprises have a ripe opportunity to capitalize on creating revenue streams. The new revenue stream is an annual, recurring, revenue-based source of profitable "annuity" to manufacturers that complements the existing revenue.

Implications:

Manufacturers that focus on optimizing their physical products through new product launches or iterative product releases will miss out on the benefits of creating a digital product that will servitize their product offerings. Missing out on servitizing the product will result in missing the opportunity to create new revenue streams due to competitive forces.

Actions:

- Identify digital skills gaps within the organization. If the organization does not possess digital skills such as software development, IoT engineering or customer experience subject matter expertise, evaluate IoT software solutions companies that can do the initial development for faster time to market.

- Identify adoption and/or leading metrics that drive customer interaction to the digital product; for example, device connects, number of subscribers and/or IoT data ingested. These metrics will reveal whether the servitized product is trending positively or negatively.

- Organize a data management strategy of customer data, and model the cost of service of the assets to create the necessary data monetization outcome (see The 3-Step Process of Contextualizing IoT and Manufacturing Data to Enable Smart Factories).

Further Reading:

3 Successful Best Practices in Servitizing Products for Manufacturers

Evidence

[1] Simulation Governance: Technical Requirements for Mechanical Design, ScienceDirect. The principles of simulation governance derive from mechanical design practice. These principles can be applied to other categories of simulation manufacturers might adopt.

2021 Gartner Logistics and Contract Manufacturing Outsourcing Survey: This survey was conducted from 31 March through 10 May 2021 to assist supply chain leaders with defining their outsourcing strategy. This survey also targets the utilization of contract manufacturing services along with anticipated and related organizational benefits. A sample of 298 supply chain professionals completed a web-based survey. Their primary workplaces were located in North America (including the U.S. and Canada), Western Europe (including the U.K., Ireland and Germany) and Asia/Pacific (including Australia, New Zealand, China, Singapore and India). Qualifying organizations operated in the manufacturing and retail industries and reported enterprisewide annual revenue for fiscal-year 2020 of at least $500 million or equivalent. Qualified participants had a role tied to a supply chain function and were in a manager or above roles. Supply chain professionals were involved in their organization's decisions regarding supply chain outsourcing. Disclaimer: Results of this survey do not represent global findings or the market as a whole, but reflect the sentiments of the respondents and companies surveyed.

2022 Gartner Industry Line-of-Business Buyer Behavior Survey: This survey was conducted to understand how business leaders in each industry are shaping technology's role in their business initiatives and operational change, and how decision makers in core business areas are making these decisions. The research was conducted online from February 2022 through April 2022 among 711 respondents in North America (n = 325 in the U.S. and Canada), Western Europe (n = 245 in the U.K., France and Germany), and APAC (n = 141 in Australia and Singapore). Qualified organizations had $50 million or more in revenue in fiscal-year 2022 across eight verticals — banking and financial services, energy and utilities, retail, manufacturing, insurance, healthcare, public sector, and telecommunications. Respondents were heads of line-of-business departments or within two reporting levels away. Moreover, they were involved in evaluating products or services for technology projects and should be aware of any exploration, purchase, replacement or renewal of technology products or services for their departments. Disclaimer: The results of this survey do not represent global findings or the market as a whole, but reflect the sentiments of the respondents and companies surveyed.

Recommended by the Authors

Some documents may not be available as part of your current Gartner subscription.

Top Strategic Technology Trends in Asset-Intensive Manufacturing for 2023 — Presentation Materials

2023 CIO and Technology Executive Agenda: An Asset-Intensive Manufacturing Perspective

Infographic: Top Priorities, Technologies and Challenges in Asset-Intensive Manufacturing in 2023

Predicts 2023: The "Triple Squeeze" Will Require Manufacturing CIOs to Gain Visibility by 2026

Top Strategic Technology Trends in Manufacturing and Transportation for 2023

Top Strategic Technology Trends in Consumer Goods Manufacturing for 2023

Table 1: Trend Profiles: Click links to jump to profiles

Realize	Elevate	Galvanize
Connected Factory Worker	Hyperautomation	Digital Design-to-Production Simulation
Industrial Data Monetization	Configuration Life Cycle Management	Automated Things Orchestration
Cloud-Edge Rebalancing	Marketplaces and Outsourced Manufacturing	Product Servitization

Source: Gartner (March 2023)

Actionable, objective insight

Position your IT organization for success. Explore these additional complimentary resources and tools for CIOs:

Research

Digital-Outcome-Driven Metrics for Manufacturing

Use this framework to identify and measure your objectives and outcomes.

Download Research

Infographic

Manufacturing Insight: How to Position Manufacturing Solutions for Environmental Sustainability

Position manufacturing solutions alongside the sustainability landscape to meet stakeholder expectations.

Download Now

Research

Quick Answer: How Can Manufacturing CIOs Use Intralogistics Smart Robots?

Evaluate how changing market dynamics impact automation levels.

Download Research

Research

Focus on Business Outcomes and Tech Innovations to Enhance Industrial IoT Edge

Explore recommendations to strengthen the use of edge deployment.

Download Research

Already a client?
Get access to even more resources in your client portal. Log In

Connect With Us

Get actionable, objective insight to deliver on your mission-critical priorities. Our expert guidance and tools enable faster, smarter decisions and stronger performance. Contact us to become a client:

U.S.: 1 855 811 7593

International: +44 (0) 3330 607 044

Become a Client

Learn more about Gartner for IT Leaders
gartner.com/en/information-technology

Stay connected to the latest insights

Attend a Gartner conference
View Conference

Gartner®